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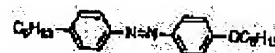
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(54) METHOD FOR ORIENTING LYOTROPIC LIQUID CRYSTAL

(57)Abstract:

PROBLEM TO BE SOLVED: To finely and stably orient a lyotropic liq. crystal contg. a solvent by bringing the liq. crystal into contact with an oriented photo-active molecule layer.

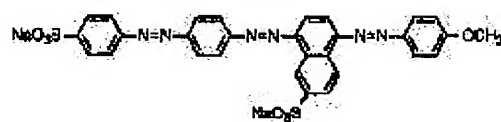


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SOLUTION: A photo-active molecule layer is oriented by diagonal irradiation with light including light which is absorbed in the photo-active molecules or by irradiation with linear polarized light and a lyotropic liq. crystal is brought into contact with the oriented photo-active molecule layer. The photo-active molecule layer is usually formed on a substrate. This substrate may be any substrate to which dichroic molecules can bond and a sheet of silica glass, hard glass, quartz or plastic optionally surface-coated with a metal oxide such as silicon dioxide or tin oxide, silicon nitride or silicon carbide may be used. The dichroic molecules can cause to vary orientation of molecular axes by the action of light.



II



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LEGAL STATUS

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the approach of carrying out orientation of the lyotropic liquid crystal. If it says in more detail, this invention will offer the approach of carrying out orientation of the lyotropic liquid crystal by irradiating slant to the linearly polarized light in the light which the optical activated molecule combined or distributed to the substrate surface layer absorbs.

[0002]

[Description of the Prior Art] As the orientation approach of liquid crystal, there is an approach into which a substrate front face is made to deform physically. For example, the rubbing approach which grinds a substrate front face against cloth etc. mechanically, slanting vacuum deposition, the method of forming a still more detailed slot, etc. are learned. In order that liquid crystal may usually carry out orientation of these only to an one direction, it is difficult to form a complicated orientation pattern with two or more directions of orientation. Or the orientation method of the liquid crystal which carries out an optical exposure is also learned by the molecular layer which combined or distributed the photoreaction nature child, and the macromolecule layer. In this case, liquid crystal arranges by using the linearly polarized light in the direction specified with a polarization shaft. According to this approach, the pattern which carried out orientation can be formed in the direction of arbitration.

[0003] The liquid crystal in which an anisotropy is shown is divided roughly into the thermotropic liquid crystal which itself shows liquid crystallinity, and the lyotropic liquid crystal in which liquid crystallinity is shown in the state of a solution. If it mixes with the isotropic substance more than a constant rate at a thermotropic liquid crystal, it separates into a liquid crystal phase and an isotropic phase, or becomes an isotropic phase, and liquid crystallinity will be spoiled or it will be destroyed. On the other hand, a lyotropic liquid crystal is a constituent which shows liquid crystallinity for the first time, and consists of a solute and a solvent at least by dissolving in a solvent etc., although the matter itself does not show liquid crystallinity. The orientation approach of the liquid crystal stated above is not a lyotropic liquid crystal as a liquid crystallinity constituent to a thermotropic liquid crystal altogether. Thus, the approach of carrying out orientation control of the lyotropic liquid crystal nature constituent containing an isotropic solvent was not learned until now.

[0004]

[Problem(s) to be Solved by the Invention] This invention gives the approach of carrying out orientation of the lyotropic liquid crystal.

[0005]

[Means for Solving the Problem] In order to develop the orientation approach of the lyotropic liquid crystal nature compound in a solvent, as a result of repeating research wholeheartedly, on the substrate, by the optical activated-molecule layer which causes molecule shaft change by the optical exposure from slant, or the linearly polarized light, this invention person found out that the orientation of a lyotropic liquid crystal was controllable, and completed this invention. Namely, the orientation approach of the lyotropic liquid crystal characterized by this invention contacting a lyotropic liquid crystal in the

optical activated-molecule layer which carried out (1) orientation, (2) [whether the light to which the orientation of an optical activated-molecule layer contains in this optical activated-molecule layer the wavelength which this optical activated molecule absorbs is irradiated from across, and] Or the orientation approach of the lyotropic liquid crystal of (1) made by irradiating the linearly polarized light, (3) (1) made after carrying out orientation of the front stirrup which contact of a lyotropic liquid crystal makes carry out orientation of the optical activated-molecule layer to an optical activated-molecule layer, or the orientation approach of the lyotropic liquid crystal of (2), (4) (1) which is the macromolecule layer which it joins together or distributes and an optical activated-molecule layer turns into in an optical activated molecule including at least one double bond chosen from $C=C$, $C=N$, and $N=N$ thru/or the orientation approach of the lyotropic liquid crystal of any 1 term of (3), (5). It is related with the lyotropic liquid crystal which is characterized by the lyotropic liquid crystal touching the optical activated-molecule layer which carried out orientation and by which orientation was carried out, [0006] It is divided roughly into the macromolecule lyotropic liquid crystal which comes to dissolve the macromolecule in which principal chains, such as a cellulosic, a polypeptide, and a nucleic acid, have a cylindrical frame in the lyotropic liquid crystal which contains a solvent so much, the amphiphilic lyotropic liquid crystal which consists of a thick water solution of an amphiphilic low molecular weight compound, and the KUROMO nick liquid crystal which consists of a solution of the low molecular weight compound which has the ring to which water solubility was given. The subject whom each of these shows liquid crystallinity is a meeting object with which not an independent low-molecular molecule but a macromolecule or low molecular weight compounds gathered, and a thermotropic liquid crystal differs from a condition remarkably. Unlike the case of a thermotropic liquid crystal, the approach of controlling the orientation of a lyotropic liquid crystal by **** on the front face of a substrate is actually learned hardly. It was unexpected that the orientation control of such a high order molecular assembly can be carried out only by irradiating light from across at the layer which combined or distributed the optical activated molecule, or irradiating the linearly polarized light.

[0007] The optical activated-molecule layer used for this invention is usually prepared on a substrate. What covered metallic oxides, such as oxidization silicon, the tin oxide, indium oxide, an aluminum oxide, titanium oxide, chrome oxide, and a zinc oxide, silicon nitride, silicon carbide, etc. is used for sheets or those front faces, such as silica system glass, hard glass, a quartz, and various plastics, that what is necessary is just what a dichroism molecule can combine as a substrate. Or the substrate which covered the front face with the metal thin film with high reflective power again can also be used.

[0008] The optical activated-molecule layer in this invention is a layer which has the optical activated molecule which causes molecule shaft orientation change by the linearly polarized light. The optical activated molecule in this invention shows the dichroism which has the property which changes with directions whose rates of the light energy of a certain wavelength range which the molecule absorbs are two of the molecules. The wavelength of the light which this kind of dichroism molecule absorbs does not remain in a light region, but the field of the ultraviolet rays and infrared radiation which are not observed with the naked eye is also included.

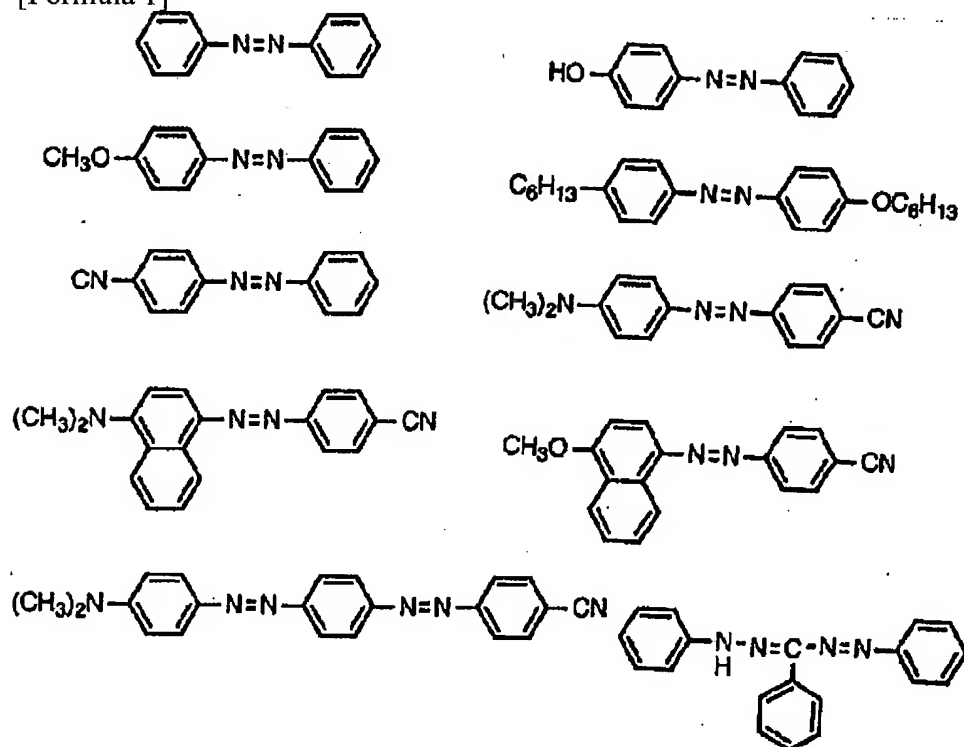
[0009] That from which the dichroism molecule used for this invention can start molecule shaft orientation change according to an operation of light is used. A molecule shaft orientation change here is a phenomenon which changes the molecule shaft orientation, after absorbing the light energy of slanting exposure light or the linearly polarized light. A dichroism molecule including the double bond chosen from at least one $C=C$, $C=N$, and $N=N$ as an optical activated molecule for this is used effectively. When these molecules combine with a substrate front face, molecule shaft orientation change is caused easily.

[0010] The example of the optical activated molecule used for this invention is shown below. As a compound which has $N=N$ association, aromatics azo-compound, such as an azobenzene, azo naphthalene, a bis-azo compound, and formazan, and the thing which makes azoxybenzene a basic frame are raised further. For example, although many of azobenzene compounds cause the optical geometrical isomerism-ized reaction from a transformer object to a cis- object by ultraviolet rays, since priority is given more to the conversion on a transformer object from a cis- object to the light of long

wave length, it is known well that optical geometrical isomerism-ization will hardly take place. In this invention, molecule shaft orientation change takes place easily also by the linearly polarized light exposure of such wavelength range that does not show a photoisomerization reaction seemingly. Furthermore, since the change on a transformer object from a cis- object takes place promptly thermally, the compound with which a photoisomerization reaction is not accepted substantially can also be used for this invention. It is not this limitation although the example of these compounds is shown in <a chemical formula 1>.

[0011]

[Formula 1]

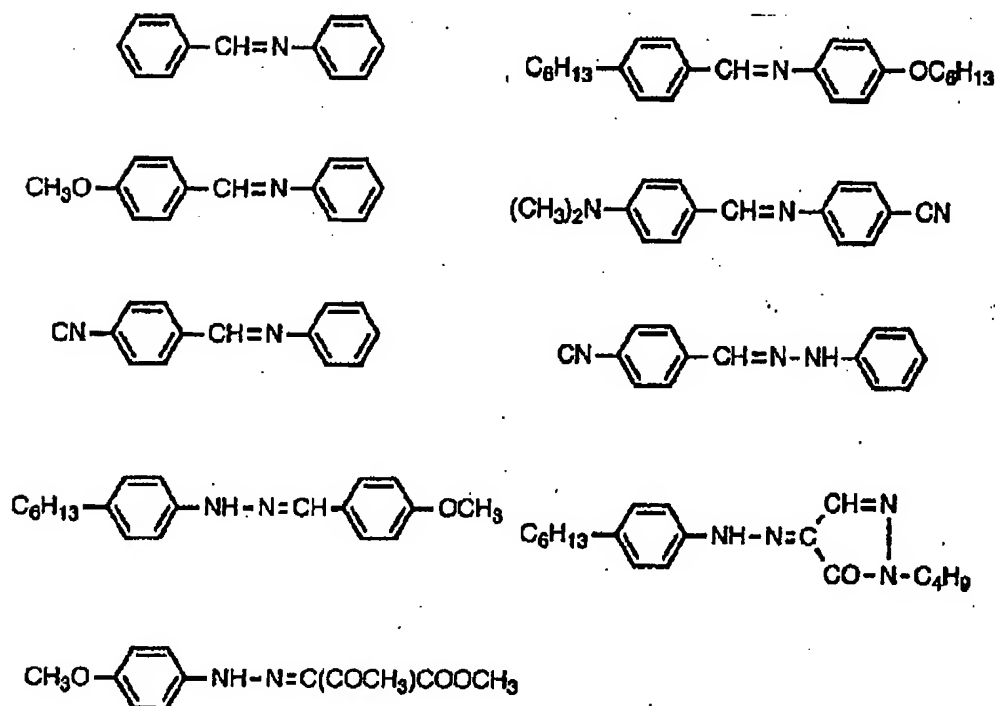


< 化学式 1 >

[0012] As a compound which has C=N association, an aromatic series Schiff base and aromatic series hydrazones can be mentioned. Although these can serve as a geometrical isomer by optical exposure, since it is unstable and returns to the structure of thermodynamically stable origin promptly, under a room temperature, substantial photoisomerization is not accepted and substantial optical geometrical isomerism-ization is not shown, for example. It is not this limitation although the example of these compounds is shown in <a chemical formula 2>.

 $[0013]$

[Formula 2]

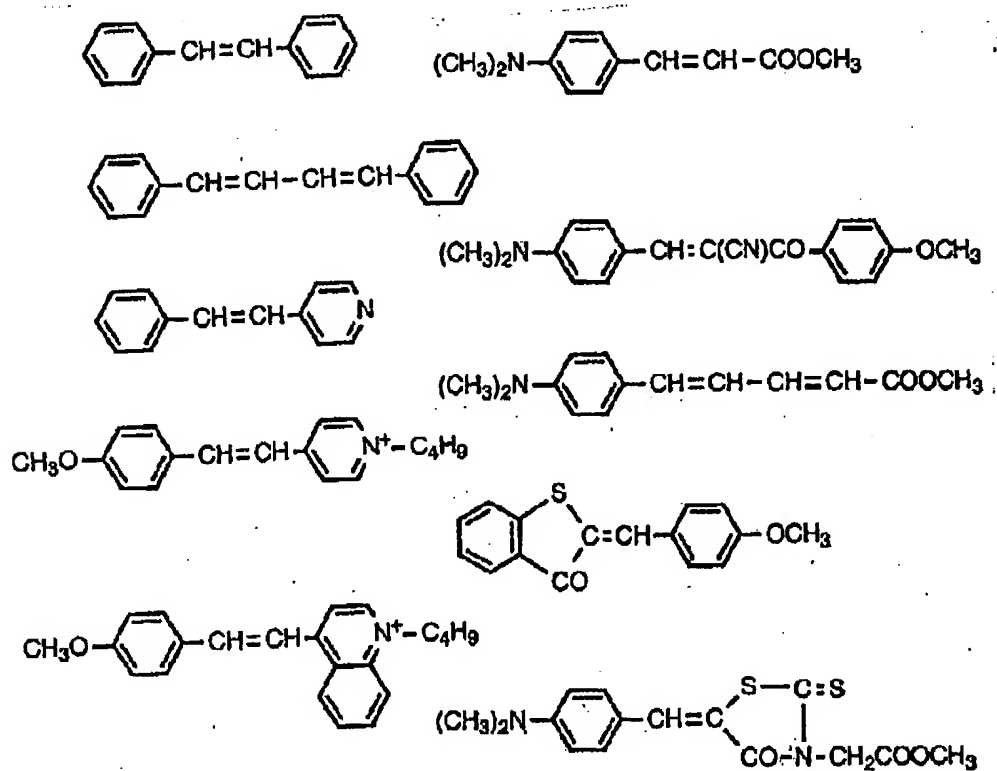


< 化学式 2 >

[0014] As a compound which has C=C association, a polyene, a stilbene, still BAZORU, still BAZORIUMU, cinnamic acid, indigo, a thioindigo, a hemi thioindigo, etc. can be mentioned. Although these many cause an optical geometrical isomerism-ized reaction, it is used like the case of an azobenzene also on the conditions geometrical isomerism-ization is not substantially accepted to be by the light of the wavelength range suitable for isomerization to a transformer object from a cis- object. It is not this limitation although the example of these compounds is shown in <a chemical formula 3>.

[0015]

[Formula 3]

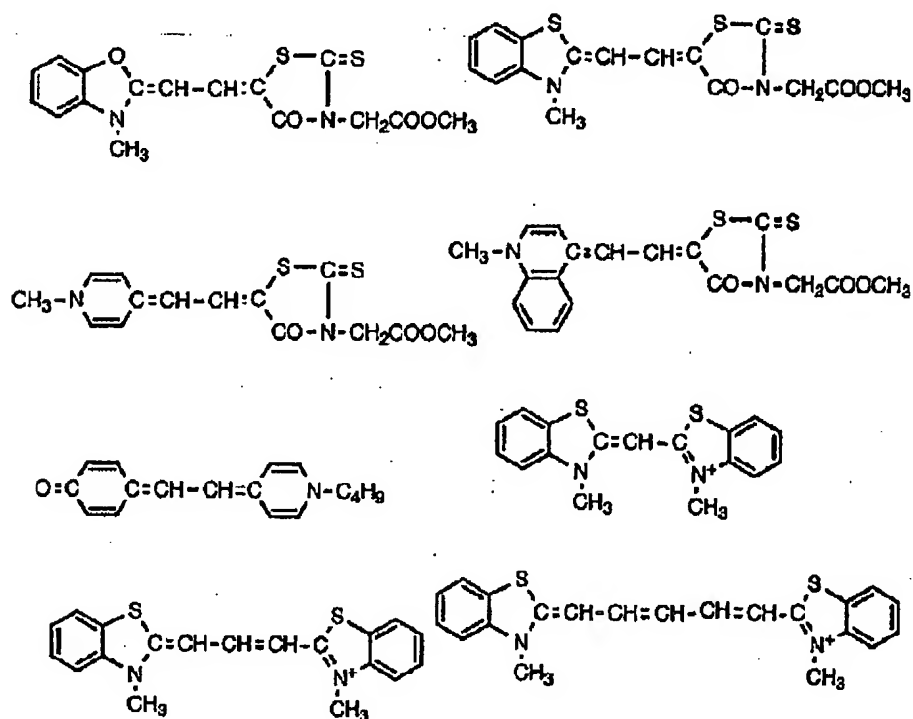


< 化学式 3 >

[0016] Moreover, since the optical geometrical isomer is unstable, return and the dichroism compound a substantial photoisomerization reaction is not accepted to be at a room temperature by optical exposure are also promptly used for the original structure. For example, cyanines and merocyanine are mentioned. It is not this limitation although the example of these compounds is shown in <a chemical formula 4>.

[0017]

[Formula 4]

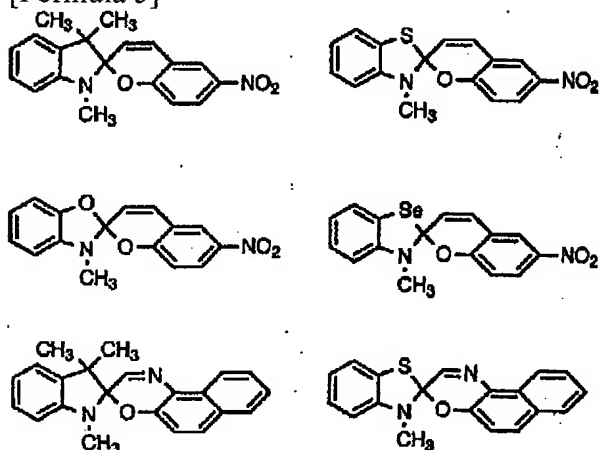


< 化学式 4 >

[0018] Furthermore, other photochromic compounds to which the molecular structure is reversibly changed by optical exposure, for example, a SUPIRO pyran, and SUPIRO oxazine can be used. Although these differ from the molecular structure shown in chemical formulas 1-4, the closing motion ring reaction of a reversible spiro ring is triggered according to an operation of light by C=C association included in intramolecular. It is not this limitation although the example of these compounds is shown in <a chemical formula 5>.

[0019]

[Formula 5]



< 化学式 5 >

[0020] These optical activated molecules are mentioned as an example of the basic frame, and even if one or more residue chosen as these frames from an alkyl group, an alkoxy group, an allyl group, an allyloxy radical, a cyano group, the alkoxy carbonyl group, the hydroxy group, the dialkylamino radical,

the nitro group, etc. has joined together, they do not interfere. Especially the alkyl group and alkoxy group which give structure similar to a liquid crystal molecule, a cyano group, an alkoxy carbonyl group, etc. are desirable.

[0021] In this invention, in order to prepare on a substrate the optical activated-molecule layer which causes such a reversible molecule shaft orientation change, there are an approach of combining physically or chemically according to the surface characteristic of a substrate and the approach of preparing the polymer solution which combined or dissolved the optical activated molecule beforehand, and applying this as a thin film on a substrate, and neither interferes. Here, the latter approach is explained.

[0022] What is necessary is just to combine an optical activated molecule with the active group which processes, and was made to carry out adsorption association with the optical activity compound which has a surface activity radical in the front face, or has been exposed to a macromolecule front face by covalent bond, when the polymeric material forms the substrate itself or the substrate surface layer. For example, if a polymeric material is polyvinyl alcohol, an optical activated molecule will be combined with the surface layer by acetal association, the ester bond, or the urethane bond. For this reason, what is necessary is to melt a dichroism molecule with a formyl group, a chloro formyl group, or an isocyanate radical to the solvent which does not dissolve polyvinyl alcohol, to make the substrate which has the polyvinyl alcohol film in this solution immersed, and just to make it react. ** what is necessary is just to add a catalyst acid like p-toluenesulfonic acid if it is acetalization in order to raise a processing reaction rate -- esterification -- urethane -- if it is-izing, in order to remove the hydrogen chloride generated at a reaction, it is effective to add bases, such as triethylamine and a pyridine.

[0023] By the approach using the macromolecule which combined the optical activated molecule, in order to combine an optical activated molecule with the side chain or principal chain of a macromolecule, the optical activated molecule which has the reactant residue which was made to carry out the polymerization of the monomer which consists of an optical activated molecule beforehand by the well-known approach, or was suitable for the chemical structure at the polymeric material is combined. Especially in the former polymerization method, the optical activated molecule which has the acrylic which has radical polymerization ability, or an methacrylic radical is suitable as a monomer, and the macromolecule which combined the optical activated molecule with the side chain is obtained easily. What is necessary is just to prepare the bifunctional monomer containing an optical activated molecule in the case of the macromolecule by polyaddition reactions, such as polycondensation reactions, such as polyester, a polyamide, and polyimide, and polyurethane.

[0024] By changing the copolymerization ratio of the monomer which consists of an optical activated molecule, the amount of association of an optical activated molecule can be adjusted. although the copolymerization ratio of the optical activity monomer suitable for this invention and other monomers is dependent also on the structure of a copolymerization monomer -- 1:0-1:10 -- it is the range of 1:0 to 1:5 more preferably. As an example of the reactive polymer used for this invention, although polyvinyl alcohol, a styrene maleic anhydride copolymer, polymethacrylic acid glycidyl, or its copolymer can be mentioned, it is not this limitation.

[0025] How to prepare the macromolecule thin film which has such an optical activated molecule in a principal chain or a side chain in a substrate front face is explained. As an approach of forming in a substrate front face, there are the revolution applying method, a dip method, and the gravure coat method and a Langmuir-Blodgett's technique. Since 1 micrometer or less is enough as thickness, the revolution applying method is used suitably especially.

[0026] Moreover, dissolution distribution of the low-molecular light activated molecule is beforehand carried out into the poly membrane, and this may be applied to a substrate front face in the shape of a thin film. The macromolecule and low-molecular light activated molecule in this case must not dissolve in the solvent solvent contained in a lyotropic liquid crystal nature constituent. Although it is desirable since especially polyimide is insoluble to solvents, such as water and alcohols, as a class of macromolecule, it is not this limitation.

[0027] Next, the actuation which carries out a linearly polarized light exposure is explained to the

substrate which prepared these optical activated-molecule layers in the front face. What is necessary is for any, such as sunlight, to be sufficient and just to choose it as a mercury-vapor lamp, a xenon LGT, a fluorescent lamp, a chemical lamp, a helium cadmium laser, argon laser, krypton laser, He Ne laser, semiconductor laser, and a pan as the light source, with an absorption wavelength field, optical irradiation time or exposure area of an optical activated molecule, etc. The optical exposures from slant are exposure conditions whose directions of incidence do not correspond in the direction of a normal over a surface layer, and the range of the include angle (this is called an incident angle below) of a normal and the direction of incidence to make is 5 times to about 30 degrees preferably 80 degrees from 1 time. Since the quantity of light which hits an unit area will fall if an incident angle is large, it will be necessary to lengthen irradiation time, and it is not desirable.

[0028] Moreover, orientation will not be generated if it is 1 or less time. Moreover, although polarization laser gives the linearly polarized light by itself, in order to make light from the light source of unpolarized light into the linearly polarized light, it should just combine a linearly polarized light component. For this reason, the polarizing plate which consists of a drawing poly membrane which dissolved the dichroism molecule other than prism system components, such as a Glan-Thompson prism, as a polarizing element is used suitably. Furthermore, the polarizing element manufactured by this invention itself can also be used. Or if a complicated pattern exposes an optical activated-molecule layer through the multi-axial polarizer currently recorded as array change of a dichroism coloring matter molecule, the pattern can be imprinted to a lyotropic liquid crystal nature constituent as it is.

[0029] although, as for exposure energy, the structure of wavelength and an optical activated molecule, an integrated state, exposure temperature, etc. are influenced in order to carry out orientation of the lyotropic liquid crystal in this invention -- 1 mJ/cm² from -- 10J/cm² The range is desirable.

[0030] Thus, it was unexpected that a lyotropic liquid crystal arranges an optical activated molecule by a slanting light exposure or linearly polarized light exposure on the substrate front face which carried out reorientation. Especially the thing that a water-soluble lyotropic liquid crystal does for orientation according to the non-hydrophilicity orientation operation of an optical activated molecule in the molecular layer which is not dissolved in water was a completely unexpected thing, when it took into consideration that an optical activated molecule could not interact with a water-soluble molecule directly.

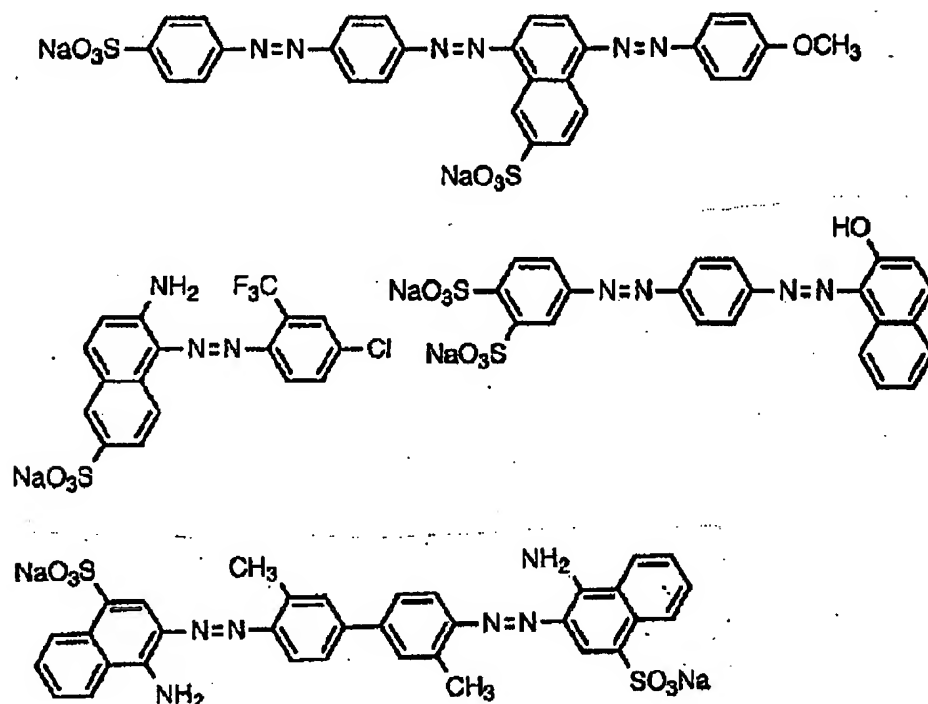
[0031] The macromolecule lyotropic liquid crystal which comes to dissolve in a solvent, the macromolecule in which principal chains, such as a cellulosic, a polypeptide, and a nucleic acid, have a cylindrical frame, for example as a lyotropic liquid crystal used by this invention, the amphiphilic lyotropic liquid crystal which consists of a thick water solution of an amphiphilic low molecular weight compound, and the KUROMO nick liquid crystal which consists of a water solution of the low molecular weight compound which has the ring to which water solubility was given are mentioned, and KUROMO nick liquid crystal is suitable especially. As a solvent, water is desirable and about 5 - 15% of the concentration is good.

[0032] KUROMO nick liquid crystal is the water solution of the compound which generally combined at least one hydrophilic residue with the molecule which makes a basic frame an aromatic series system ring structure suitable in order to maintain the planar structure, and concentration is about 2 - 20%. Moreover, a surfactant and salts may be added unless liquid crystallinity is checked in this water solution. As a concrete compound, there are some which have the molecular structures, such as an azobenzene system, a cyanine system, and a phthalocyanine system, and the molecular structure of a chromone system and a xanthone system.

[0033] The example of the compound of an azobenzene system is given in <a chemical formula 6>.

[0034]

[Formula 6]



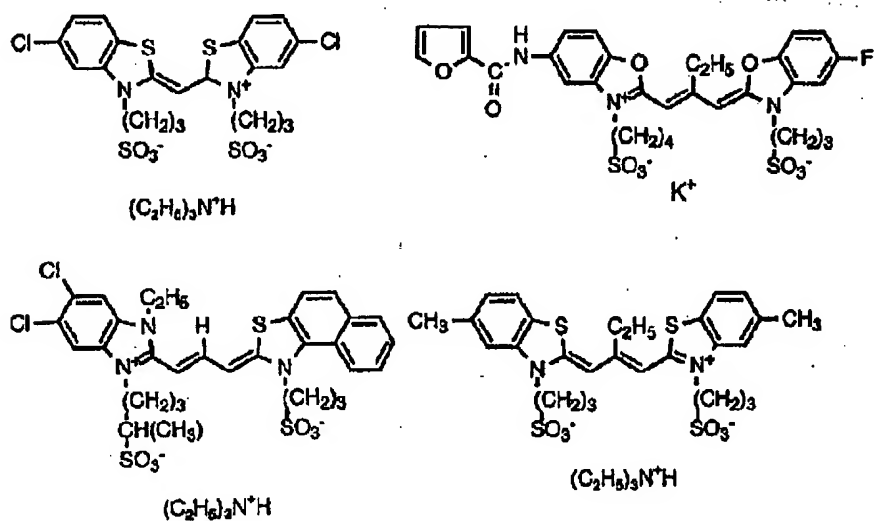
< 化学式 6 >

[0035] Thus, it is not this limitation although a thing with a phenyl group, a naphthalene radical, and a biphenyl frame is mentioned.

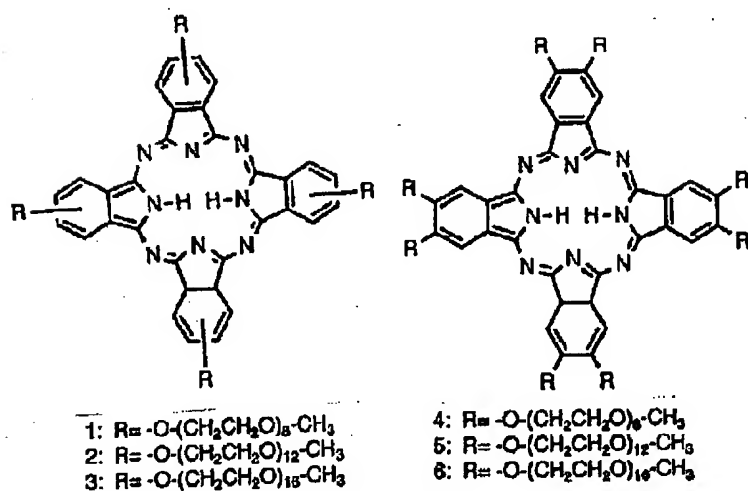
[0036] Next, it is not this limitation although the typical example of the compound of a cyanine system and a phthalocyanine system is given in <a chemical formula 7> and <a chemical formula 8>, respectively. .

[0037]

[Formula 7]



< 化学式 7 >

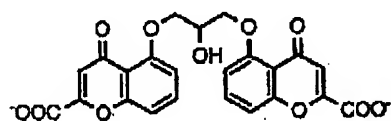


< 化学式 8 >

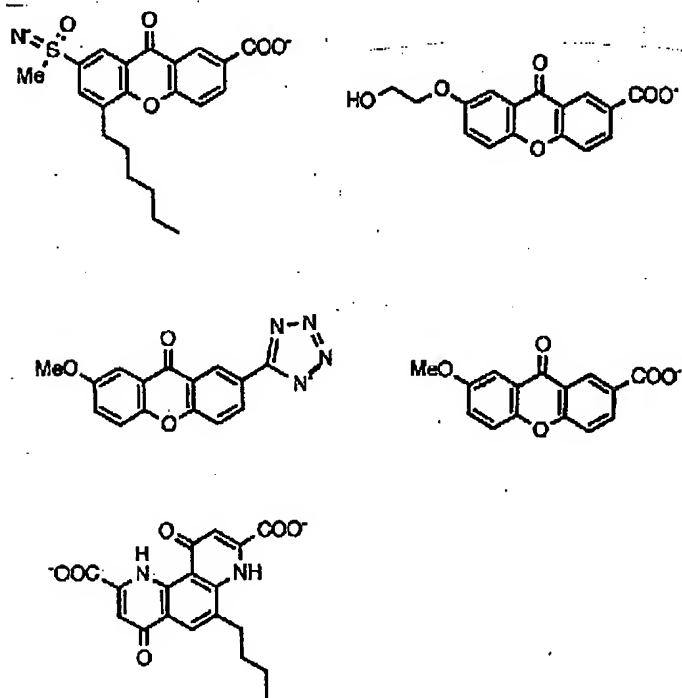
[0038] Next, it is not this limitation although the typical example of the compound of a chromone system and a xanthone system is given in <a chemical formula 9> and <a chemical formula 10>, respectively.

[0039]

[Formula 8]



< 化学式 9 >



< 化学式 10 >

[0040] In order to carry out orientation of the lyotropic liquid crystal, after slanting-light-irradiating or linearly polarized light irradiating at an optical activated-molecule layer, where it could prepare the solution layer of a lyotropic liquid crystal nature compound on it or the solution layer of a lyotropic liquid crystal nature compound is contacted in an optical activated-molecule layer, it may slanting-light-irradiate or linearly polarized light irradiate. In the case of the latter, temperature up of the lyotropic liquid crystal may be carried out, it may change into an isotropic phase condition, and an optical exposure may be carried out.

[0041] Next, an example explains this invention to a detail further.

Revolution spreading of the 2% toluene solution of example 1 Pori (4-methacryloyloxy azobenzene) was carried out on the glass substrate, and the polymer thin film was obtained. After ****ing the film inside for two glass substrates which applied this film and using a 25-micron film spacer, a cel is created, and it is the 436nm linearly polarized light to this 1 J/cm² It irradiated with the quantity of light. This empty cel was filled up with the water solution made to dissolve the violet blue (C. I. Direct blue 67) 10 section and the nonionic surface active agent 1 section in the water 89 section. This cel was observed through the polarizer, orientation of a result and the coloring matter molecule was carried out in the direction of a right angle to the polarization shaft of the irradiated linearly polarized light, and the order parameter was 0.68. Although the orientation of coloring matter disappeared when this cel was heated at 55 degrees C, orientation was reproduced by [of a room temperature] returning.

[0042] It is the linearly polarized light to the whole surface of the empty cel created like example 2 example 1 1 J/cm² It is the linearly polarized light which the photo mask was placed [linearly polarized light] on the cel and rotated the polarization shaft 90 degrees after irradiating with the quantity of light again 1 J/cm² It irradiated with the quantity of light. It was filled up with the water solution which

consists of violet blue and a nonionic surface active agent like an example 1. As a result of observing this cel through one polarizer, the image of coloring matter faithful to a photo mask was observed.

[0043] Revolution spreading of the 2% toluene solution of example 3 Pori (4-methacryloyloxy azobenzene) was carried out on the glass substrate, and the polymer thin film was obtained. After ***ing the film inside for two glass substrates which applied this film and using a 25-micron film spacer, a cel is created, and it is the 436nm linearly polarized light to this 1 J/cm² It irradiated with the quantity of light. When the water solution made to dissolve the KUROMOGU rucksack acid disodium salt 11.6 section and the Nonion system surfactant 0.1 section in the water 88.3 section was observed with the polarization microscope, the schlieren organization equivalent to a nematic phase was checked. After filling up a cel with this water solution, when it observed between the polarizers of two sheets which intersect perpendicularly, light and darkness were accepted for every 90 revolutions. This is as a result of generating of the birefringence by 1 shaft orientation.

[0044] It is the linearly polarized light to the whole empty cel surface created like example 4 example 3 1 J/cm² 1 J/cm² which rotated the polarization shaft 90 degrees after irradiating with the quantity of light The linearly polarized light of the quantity of light was again irradiated over the photo mask. After filling up an empty cel with the water solution which consists of the same KUROMOGU rucksack acid disodium salt as an example 3, and an Nonion system surfactant, when it observed between the polarizers of two sheets which intersect perpendicularly, the light and darkness of an image faithful to a photo mask were accepted for every 90 revolutions.

[0045] The example 5 Pori (p-meta-clo yloxy methyl cinnamate) 0.2 section was dissolved in the dichloromethane 49.9 section and the chlorobenzene 49.9 section. It prepared by revolution spreading on the glass substrate which washed this solution, the 25-micron spacer film was inserted so that a spreading side might be carried out inside for these two substrates, and the cel was created. It is the 313nm linearly polarized light to this cel 1 J/cm² It filled up with the water solution which consists of the coloring matter and the Nonion system surfactant which were used in the example 1, after irradiating with the quantity of light. By observing this cel through a polarizer showed that dichroism was shown. Carrying out orientation of the coloring matter molecule vertically to an exposure polarization shaft was checked from the polarization absorption spectrum of coloring matter.

[0046] Like example 6 example 5, the thin film of Pori (p-meta-clo yloxy methyl cinnamate) was prepared by revolution spreading on the glass substrate, and the cel was created using these two substrates. It is the 313nm linearly polarized light to this cel 1 J/cm² It filled up with the water solution which consists of the coloring matter and the Nonion system surfactant which were used for this cel in the example 1, after irradiating with the quantity of light. When this cel was observed through one polarizer, it turned out that orientation of the coloring matter molecule is carried out in the direction of a right angle to the polarization shaft of the irradiated linearly polarized light. Although the orientation of coloring matter disappeared when this cel was heated at 55 degrees C, orientation was reproduced by returning to a room temperature.

[0047] The polymerization of the example 74-cyano-4'-methacryloyl azobenzene was carried out at 65 degrees C by having made azobisisobutyronitril into the initiator in THF for 8 hours, and the homopolymer was obtained. Revolution spreading of the solution made to dissolve this polymer 0.7 section in the cyclohexanone 99.3 section was carried out on two glass substrates, and it was made the cel by making a spreading side into the inside. It is the linearly polarized light of 436nm(s) to this cel 1 J/cm² It filled up with the water solution which consists of the coloring matter and the Nonion system surfactant which irradiated with the quantity of light and were used in the example 1. Orientation of the coloring matter molecule is carried out to parallel from the polarization absorption spectrum to the exposure polarization shaft, and the order parameter showed 0.66.

[0048] The radical polymerization of the 1:1 mixture of an example 84-cyano-4'-methacryloyl azobenzene and acrylonitrile was carried out like the example 7, and the copolymer was obtained. Revolution spreading of the solution made to dissolve this copolymer 0.7 section in the cyclohexanone 99.3 section was carried out on two glass substrates, and it was made the cel by making a spreading side into the inside. It is 1 J/cm² with the same approach as an example 7. The linearly polarized light of the

quantity of light was irradiated, and it filled up with the water solution which consists of the coloring matter and the Nonion system surfactant which were used in the example 1. Orientation of the coloring matter molecule is carried out to parallel from the polarization absorption spectrum to the exposure polarization shaft, and the order parameter showed 0.68.

[0049]

[Effect of the Invention] According to the orientation approach of this invention, with a conventional method, orientation of the lyotropic liquid crystal in the condition of having contained the impossible solvent can be carried out to a detail and stability. Various displays are attained by combining with two or more polarizing plates.

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CLAIMS

[Claim(s)]

[Claim 1] The orientation approach of the lyotropic liquid crystal characterized by contacting a lyotropic liquid crystal in the optical activated-molecule layer which carried out orientation.

[Claim 2] The orientation approach of the lyotropic liquid crystal of claim 1 made by irradiating from across the light to which the orientation of an optical activated-molecule layer contains in this optical activated-molecule layer the wavelength which this optical activated molecule absorbs, or irradiating the linearly polarized light.

[Claim 3] The front stirrup which contact of a lyotropic liquid crystal makes carry out orientation of the optical activated-molecule layer to an optical activated-molecule layer is the orientation approach of claim 1 made after carrying out orientation, or the lyotropic liquid crystal of 2.

[Claim 4] The orientation approach of the lyotropic liquid crystal of claim 1 which is the macromolecule layer which it joins together or distributes and an optical activated-molecule layer turns into in an optical activated molecule including at least one double bond chosen from C=C, C=N, and N=N thru/or any 1 term of 3.

[Claim 5] The lyotropic liquid crystal which is characterized by the lyotropic liquid crystal touching the optical activated-molecule layer which carried out orientation and by which orientation was carried out.

[Translation done.]